

## CLAIMS

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1. A molecular circuit, comprising (a) a first nucleic acid molecule that comprises a gene encoding a transcription factor and a first promoter activatable by stress and by the transcription factor, wherein the first promoter and the transcription factor gene are operably linked, and (b) a second nucleic acid molecule that comprises a gene of interest and a second promoter activatable by the transcription factor, wherein the second promoter and the gene of interest are operably linked.

2. The molecular circuit of claim 1, wherein a single nucleic acid molecule comprises the first nucleic acid molecule and the second nucleic acid molecule.

3. The molecular circuit of claim 1, wherein the transcription factor is a mutated heat shock transcription factor (HSF).

4. The molecular circuit of claim 3, wherein the mutated HSF is derived from a vertebrate HSF or from an insect HSF.

5. The molecular circuit of claim 4, wherein the vertebrate HSF is a mammalian HSF or an avian HSF.

6. The molecular circuit of claim 1, wherein the transcription factor is a chimeric transcription factor.

7. An expression vector comprising the molecular circuit of claim 2.

8. A set of expression vectors, comprising a first expression vector comprising the first nucleic acid molecule of claim 1, and a second expression vector comprising the second nucleic acid molecule of claim 1.

9. A molecular circuit comprising (a) a first nucleic acid molecule that comprises a gene encoding a transcription factor and a first promoter activatable by stress, wherein the first promoter and the transcription factor gene are operably linked, (b) a second nucleic acid comprising a gene encoding the transcription factor and a second promoter activatable by the transcription factor, wherein the second promoter and the transcription factor gene are operably linked, and (c) a third nucleic acid molecule that comprises a gene of interest and a third promoter activatable by the transcription factor, wherein the third promoter and the gene of interest are operably linked.

10. The molecular circuit of claim 9, wherein a single nucleic acid molecule comprises the first nucleic acid molecule and the second nucleic acid molecule.

11. The molecular circuit of claim 9, wherein a single nucleic acid molecule comprises the first nucleic acid molecule, the second nucleic acid molecule, and the third nucleic acid molecule.

12. An expression vector comprising the single nucleic acid molecule of claim 11.

13. A set of expression vectors, comprising a first expression vector comprising the first nucleic acid molecule of claim 9, a second expression vector comprising the second nucleic acid molecule of claim 9, and a third expression vector comprising the third nucleic acid molecule of claim 9.

14. A set of expression vectors, comprising a first expression vector that comprises the first and second nucleic acid molecules of claim 9, and a second expression vector that comprises the third nucleic acid molecule of claim 9.

15. A molecular circuit comprising (a) a first nucleic acid molecule that comprises a gene encoding a first transcription factor and a first promoter activatable by

stress, wherein the first promoter and the first transcription factor gene are operably linked, (b) a second nucleic acid comprising a gene encoding a second transcription factor and a second promoter activatable by the first transcription factor and the second transcription factor, wherein the second promoter and the second transcription factor gene are operably linked, and (c) a third nucleic acid molecule that comprises a gene of interest and a third promoter activatable by the second transcription factor, wherein the third promoter and the gene of interest are operably linked.

16. The molecular circuit of claim 15, wherein a single nucleic acid molecule comprises the first nucleic acid molecule and the second nucleic acid molecule.

17. The molecular circuit of claim 15, wherein a single nucleic acid molecule comprises the first nucleic acid molecule, the second nucleic acid molecule, and the third nucleic acid molecule.

18. An expression vector comprising the first, second, and third nucleic acid molecules of claim 15.

19. A set of expression vectors, comprising a first expression vector comprising the first nucleic acid molecule of claim 15, a second expression vector comprising the second nucleic acid molecule of claim 15, and a third expression vector comprising the third nucleic acid molecule of claim 15.

20. A set of expression vectors, comprising a first expression vector that comprises the first and second nucleic acid molecules of claim 15, and a second expression vector that comprises the third nucleic acid molecule of claim 15.

21. The molecular circuit of claim 1, wherein the gene of interest encodes a transactivator, and wherein the molecular circuit further comprises a nucleic acid molecule

comprising a second gene of interest and a promoter activatable by the transactivator, wherein the second gene of interest and the transactivator-activatable promoter are operably linked.

22. A molecular circuit, comprising (a) a first nucleic acid molecule that comprises a gene encoding a transcription factor and a first promoter activatable by stress, wherein the first promoter and the transcription factor gene are operably linked, and (b) a second nucleic acid molecule that comprises a gene of interest, the transcription factor gene, and a second promoter activatable by the transcription factor, wherein the second promoter is operably linked with the gene of interest and the transcription factor gene.

23. The molecular circuit of claim 22, wherein a single nucleic acid molecule comprises the first nucleic acid molecule and the second nucleic acid molecule.

24. An expression vector comprising the single nucleic acid molecule of claim 23.

25. A set of expression vectors, comprising a first expression vector comprising the first nucleic acid molecule of claim 22, and a second expression vector comprising the second nucleic acid molecule of claim 22.

26. A recombinant eukaryotic host cell, comprising either the expression vector of any one of claims 7, 12, 18, or 24, or an expression vector set of any one of claims 8, 13, 14, 19, 20, or 25, wherein the host cell is selected from the group consisting of insect cell, avian cell, yeast cell, and mammalian cell.

27. A method of producing a protein of interest, comprising the steps of:

- (a) culturing the recombinant host cells of claim 26,
- (b) stimulating the first promoter by exposing the cultured recombinant cells to stress, and

(c) isolating the protein of interest from the cultured recombinant host cells, wherein the protein of interest is expressed by the gene of interest.

28. The method of claim 27, wherein the step (b) is achieved by heating the recombinant host cells.

29. The method of claim 27, wherein the recombinant host cell is a mammalian cell.

30. A virus, comprising the expression vector of any one of claims 7, 12, 18, or 24.

31. The virus of claim 30, wherein the virus is selected from the group consisting of adeno-associated virus, adenovirus, *Herpes simplex* virus, alphavirus, and pox virus.

32. A pharmaceutical composition, comprising a pharmaceutically acceptable carrier and either the expression vector of any one of claims 7, 12, 18, or 24, or an expression vector set of any one of claims 8, 13, 14, 19, 20, or 25.

33. A pharmaceutical composition, comprising a pharmaceutically acceptable carrier and the virus of claim 30.

34. A method of treating a subject with a protein of interest, comprising the steps of:

(a) administering the pharmaceutical composition of either claim 32 or claim 33 to the subject, and

(b) applying heat to the area of the subject in need of the protein of interest, wherein the heat treatment results in the stimulation of the expression of the gene of interest.

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34 ~~35~~. A method of stimulating the expression of a gene of interest in a recombinant cell, comprising the steps of:

- (a) producing a recombinant host cell by introducing into a host cell either the expression vector of any one of claims 7, 12, 18, or 24, or an expression vector set of any one of claims 8, 13, 14, 19, 20, or 25, and
- (b) exposing the recombinant host cell to a condition of stress, wherein the stress exposure stimulates the first promoter to increase expression of the gene operably linked to the first promoter, which in turn, results in the stimulation of expression of the gene of interest.

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